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NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

OPERATIONS

Factual Report

CEN14FA046

Contents

A. ACCIDENT

Operator: Private individual

Location: Owasso, Oklahoma

Date: November 10, 2013

Time: 1546 Central Standard Time (CST)[1]

Airplane: Mitsubishi MU-2B-25, N856JT

B. OPERATIONS GROUP

Chairman: Jason Aguilera
National Transportation Safety Board
Denver, CO

Member: Evan Byrne
National Transportation Safety Board
Washington, DC

Member: Aaron Sauer
National Transportation Safety Board
Denver, CO

Member: David Keenan
Federal Aviation Administration
Washington, DC

Member: John Vetter
Federal Aviation Administration
Kansas City, MO

Member: Ralph Sorrells
Mitsubishi Heavy Industries, Ltd
Addison, TX

[1]All times are Central Standard Time (CST) and based on a 24-hour clock unless otherwise noted. Time of accident is approximate.

C. SUMMARY

On November 10, 2013, about 1546 central standard time, a Mitsubishi MU-2B-25 twin-engine airplane, N856JT, impacted wooded terrain while maneuvering near Owasso, Oklahoma. The commercial pilot, who was the sole occupant of the airplane, sustained fatal injuries. The airplane was destroyed. The airplane was registered to Anasazi Winds, LLC, Tulsa, Oklahoma, and was operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Visual meteorological conditions prevailed for the flight, and an instrument flight plan had been filed. The flight departed Salina Regional Airport (KSLN), Salina, Kansas, about 1500, and was en route to Tulsa International Airport (KTUL), Tulsa, Oklahoma.

D. DETAILS OF THE INVESTIGATION

The Operations Group conducted a total of 10 interviews of 7 people (one person was interviewed three times). In addition, 8 eyewitnesses provided accounts of the accident. Transcripts and records of conversation are located in Attachments 1 through 4 of this report.

E. LIST OF ACRONYMS

AOA	Angle of attack
Agl	Above Ground Level
FAA	Federal Aviation Administration
GPS	Global Positioning System
KSLN	Salina Regional Airport, Salina, Kansas
kts	Knots
KTUL	Tulsa International Airport, Tulsa, Oklahoma
msl	Mean Sea Level
NTS	Negative Torque Sensing System
PFT	Professional Flight Training
SFAR	Special Federal Aviation Regulation
VFR	Visual Flight Rules
V_{mc}	Minimum control speed
V_{ne}	Airspeed that should not be exceeded
V_{no}	Maximum normal operating airspeed
V_{so}	Stall speed in the landing configuration
V_{xse}	Best angle of climb speed, single engine
V_{yse}	Best rate of climb speed, single engine

F. FACTUAL INFORMATION

1.0 History of Flight

According to air traffic control communications and radar data, the airplane was cleared to land on runway 18L at TUL, and the pilot was instructed to reduce the airplane's airspeed to 150 knots for an airplane that was departing from runway 18L. The pilot acknowledged the clearance and speed reduction. Radar data depicted the airplane on a straight-in approach to runway 18L. After the airplane passed the vicinity of runway 18L's outer marker, the airplane began a left

turn. After the airplane had turned left approximately 90 degrees from the original heading, the air traffic control tower controller queried the pilot, and the pilot reported, "I've got a control problem[2]." The airplane continued the left turn, and the controller then cleared the pilot to maneuver to the west and asked if he needed assistance. The pilot informed the controller, "I've got a left engine shutdown." The controller then declared an emergency for the pilot and asked about the number of persons on-board the airplane and the fuel remaining. No further communications were received from the pilot. Radar data showed the airplane completed about a 360-degree left turn at 1,100 feet mean sea level (msl), before radar contact was lost.

The accident site was located in a wooded area about 5 miles north of KTUL at a GPS elevation of about 650 feet msl. The airplane came to rest upright on a measured magnetic heading of 109 degrees. The main wreckage area consisted of all major airplane structure and components. The left engine propeller blades were found in a feathered position. The landing gear was found in the extended position, and both flaps were in the 20-degree position. Postimpact fire consumed a majority of the fuselage and wing structure.

2.0 Witness Statements

Eight witnesses provided accounts of the accident sequence which are compiled in attachment 4 of this report. Several witnesses observed the airplane in a shallow left turn; the reported altitudes ranged from 400 to 800 feet above ground level. During the turn, four witnesses recalled the landing gear in the extended position, and two witnesses observed that one propeller not rotating or was slowing. One of the witnesses reported seeing a stream of black exhaust following the airplane and four other witnesses reported not seeing any smoke. Four of the witnesses reported an unusual engine or propeller noise from the airplane, and the other four did not comment on the engine or propeller noise. Some of the witnesses observed the airplane in a left turn towards the west before the wings began to rock left and right at 10-15 degree bank angles. Shortly thereafter, the airplane was seen in a bank to right followed by a "hard" bank to the left. Some of the witnesses observed the airplane spiral towards the ground and disappear from view.

3.0 Personnel Information

The pilot, age 51, held commercial and flight instructor ratings. He was employed as an orthopedic surgeon and flew for recreation purposes. He lived with his wife of 24 years and their two sons.

The pilot's wife was interviewed to reconstruct the pilot's 72 hour history. A synopsis of the interview is located in Attachment 3 of this report. The pilot's wife reported that the pilot normally woke every day about 0430 and rarely slept past 0630. He did not take naps during the day and usually got ready for bed around 2130 where the pilot read until about 2230. During his sleep period, the pilot would not wake during the night. The pilot had previously snored but wore adhesive nasal strips to remedy his snoring.

[2] Quotes from Air Traffic Control transcript, Aircraft Accident Package TUL-ATCT-0091

The pilot was not known to eat breakfast regularly and his lunch often consisted of a candy bar or other food obtained at work. A balanced dinner was normally served around 1800-1830 daily. Other than meals, the pilot did not snack during the day. The pilot had a previous habit of drinking multiple diet sodas daily, but had reduced his intake to 1 per day. He was not prescribed any medications and did not take any over-the-counter medication on a regular basis. The pilot occasionally drank alcohol, but no more than a single glass of red wine. The pilot belonged to a fitness center and exercised on a daily basis. There were no recent changes in the pilot's personal life or professional career.

Records obtained for the pilot's cellphone recorded his usage in the days preceding the accident. Table 1 shows the activity of the pilot's phone.

Date	Time and type of first event	Time and type of last event
7 November	0739, phone call	2048, data usage
8 November	0752, phone call	2210, SMS sent
9 November	0808, data usage	2209-2226, phone call
10 November	0758, data usage	1444, SMS sent

Table 1. Pilot's Cellphone Usage

There are no known impacts to the pilot's normal sleep schedule.

3.1.1 Certifications

The pilot's certification history is summarized in Table 2. In addition to the certificates and endorsements listed, he renewed his flight instructor certificate biennially every February from 2002-2012. He most recently renewed his flight instructor certificate on October 6, 2013, when he added an airplane multiengine endorsement.

Certificate Type	Completion Date
Private Pilot – Airplane Single Engine Land	8/17/1983
Instrument Airplane Rating	10/12/2000
Commercial Pilot – Airplane Single Engine Land	11/20/2000
Flight Instructor – Airplane Single Engine	10/4/2001
Flight Instructor – Instrument Airplane	2/2/2002
Commercial Pilot – Multiengine Land	8/12/2002
Flight Instructor – Airplane Multiengine	10/6/2013

Table 2. Pilot's Certification History

3.1.2 Flight Experience

Previous copies of the pilot's log books were provided to investigators and remnants of the pilot's current log book were found at the accident site. According to these records, at the time of the accident, the pilot had at least 2,874.4 total flight hours of which about 1,534.9 hours were in multi-engine airplanes. According to the pilot's wife, he rarely flew alone and usually flew with friends or family. The pilot logged most of his multiengine time in a Cessna 421B, which he owned. In addition, he performed training for his Flight Instructor – Airplane Multiengine rating in a Piper PA-44-180. The pilot had recently purchased the MU-2B-25 airplane.

3.1.3 Other Pilots' Perceptions of His Flying Skills

Interviews were conducted with three pilots who flew with the accident pilot in the months prior to the accident. Records of conversation with these pilots are located in Attachment 1. Although interviewed separately and not associated with each other, all three pilots had similar descriptions of the accident pilot. They described him as a very good aviator who was studious, meticulous, and humble of his flight abilities. All three attested to the pilot's practice of flying in accordance with the manufacturer's guidance and meticulously followed the manufacturer's checklists. None of interviewed pilots recalled any negative or bad habits that the pilot possessed.

3.2 Single Pilot Operations

According to the pilot's wife, he rarely flew alone and more often flew with family or friends. Earlier in the year, the pilot had contacted another MU-2 and asked if that pilot would be a mentor pilot for him, and fly with the pilot occasionally when he finished training.

4.0 Communications and Radar

The pilot radioed Tulsa Approach at 1534 stating that the airplane was descending to 10,000 msl. The approach controller informed him to expected radar vectors for the visual approach to runway 18L. The pilot replied that he had the current automated weather information and initially responded with "46[3]" (similar to his Grumman AA5B callsign) and corrected himself with "6JT." The pilot was given radar vectors for the visual approach and a descent to 2,500 feet msl. The pilot advised he had the airport in sight and was cleared to change frequency to Tulsa Tower.

At 1542:20 the pilot contacted Tulsa Tower and the tower controller requested that the pilot slow to 150 knots or less for a departing airplane. The pilot responded that he was reducing speed and responds with "46, 46J" then corrected to "56JT." Radar data showed that at 1543:27, the airplane levelled off momentarily at 2,200 feet msl and slowed through 151 knots[4]. After this time, the airplane began a 1,200-1,500 foot per minute descent to about 1,115 feet and slowed to about 95 knots. At 1544:23, the airplane began a left turn at 95 knots. At 1544:48, the airplane had turned about 90 degrees to the left away from the approach course and the tower controller contacted the pilot who responded that he had a control problem. The controller cleared the pilot to maneuver and asked if he needed assistance. At 1545:06, the pilot radioed that he had "a left engine shutdown[5]" and radar depicted the airplane in a left turn at 85 knots at the time of this transmission. The pilot made no further radio transmissions. Radar information tracked the

[3] Quotes from Air Traffic Control transcript, Aircraft Accident Package TUL-ATCT-0091
[4] All speeds from this point forward in the report are listed as calibrated airspeed (CAS) unless otherwise stated.

airplane in a left turn as its speed varied between 85-95 knots, it momentarily increased to 101 knots before it decreased to 75 knots.

5.0 Medical and Pathological Information

The pilot's wife, also a doctor, assessed the pilot's health in "excellent" condition. He had not been diagnosed with any medical conditions.

The pilot's most recent FAA third class medical certificate was dated October 15, 2013. It had no limitations. On the pilot's application for his medical certificate, he reported not using any medications and reported no medical history conditions in block 18.

An autopsy was performed on the pilot by the Office of the Chief Medical Examiner, Oklahoma City, Oklahoma. The autopsy ruled the cause of death as the result of multiple blunt force injuries and the manner of death as an accident. No unusual findings were discovered during the autopsy.

Biological specimens from the pilot's body were forwarded to the FAA's Civil Aerospace Medical Institute (CAMI) for toxicological testing. These specimens tested negative for ethanol and detected ibuprofen.[6] Ibuprofen is a nonnarcotic analgesic and anti-inflammatory agent used to treat aches and pains, and as an antipyretic to reduce fever[7]. The results of the toxicology are located in Attachment 5.

6.0 Training

The Mitsubishi MU-2B series airplane requires special training, experience, and operating requirements. These requirements are listed in the FAA's Special Federal Aviation Regulation (SFAR) No. 108[8], which was published on February 6, 2008. Pilots complete initial or transition training if they have fewer than 50 hours of documented flight time manipulating the controls while serving as pilot-in-command of an MU-2B series airplane in the preceding 24 months or fewer than 500 hours of documented flight time manipulating the control while serving as pilot-in-command of an MU-2B series airplane. For initial training, the SFAR requires a minimum of 20 hours of ground instruction and a minimum of 12 hours of flight instruction, with a minimum of 6 hours accomplished in the airplane, a level C simulator, or a level D simulator.

During training, five special emphasis items are presented and evaluated during the training program. They include:

- Accelerated stall awareness and recovery procedures with emphasis on configuration

[6] Immunoassay and chromatography were used to screen for the following drugs: amphetamine, opiates, marihuana, cocaine, phencyclidine, benzodiazepines, barbiturates, antidepressants, antihistamines, meprobamate, methaqualone, and nicotine.
[7] FAA CAMI's Forensic Toxicology's Webdrugs database
[8] Special Federal Aviation Regulation No. 108, Docket No. FAA-2008-0938

management.
- V_{mc} (minimum control speed) and early recognition.
- Airspeed management and recognition of airspeed deterioration below recommended speeds and recovery methods.
- Knowledge of icing conditions and encounters.
- Airplane performance characteristics with all engines operating and with one engine inoperative.

Upon completion of the training, a pilot cannot act as pilot-in-command of an MU-2B series airplane unless they have logged a minimum of 100 flight hours as pilot-in-command of multiengine airplanes.

All training and operations conducted in the MU-2B series airplane must be completed in accordance with the applicable MU-2B series checklist or a checklist accepted by the FAA's MU-2B Flight Standardization Board.

6.1 Pilot's Training

The pilot's MU-2B-25 ground school was conducted November 4-10, 2013, at Professional Flight Training, Salina, Kansas. He was the sole student in the class and the training cadre consisted of one SFAR certified flight instructor, the school's owner. The instructor reported that ground school with the pilot took approximately 32 hours which was consistent with the time normally allotted to teach new pilots.

The entire flight portion of the pilot's training was conducted in the accident airplane, N856JT. The first flight was conducted on November 7, 2013, which was flown around the local area of Tulsa, Oklahoma. The second flight was conducted between Tulsa, Oklahoma, and Salina, Kansas. After the airplane landed at KSLN, the remaining flights were flown in the local area of KSLN. The instructor created training records for each flight and the maneuvers flown were graded using numbers one through four to grade poor, fair, average, and excellent, respectively. The pilot's scores on the first flight were on average 2.8 or just below "average." On each subsequent flight the pilot progressed, with no evidence of regression in any area and on the final flight, his maneuvers were about 3.8 or nearly "excellent."

The SFAR requires pilots to accrue 12 hours of flight instruction and the definition of flight instruction is not provided. Flight instruction can include the time from engine start until engine shutdown. Documentation provided by the instructor recorded the time allotted for training. Two total hour metrics were tracked for each flight, the Hobbs meter time and a "block time." The Hobbs time recorded airplane operation with weight off of the landing gear, which is determined by a squat switch on the left main landing gear. The block time recorded the time from when the airplane began taxiing from parking to the runway and the time that it returned to parking. During training, the accident airplane recorded 11.5 hours of Hobbs time and 16 hours and 35 minutes of block time.

According to the instructor, the airplane did not experience any actual malfunctions or failures during their course of training. All malfunctions and failures experienced by the pilot were simulated, set up and flown in a training environment.

On November 10, 2013, the morning of the accident, the pilot satisfactorily completed his phase check to be endorsed in the MU-2B-25. The accident flight was the first time the pilot flew single pilot in the MU-2.

6.1.1 Training Maneuvers Accomplished

The grade sheets completed by the instructor pilot recorded the maneuvers flown during each training flight and the evaluation flight. The exact number of maneuvers flown under one category was not recorded, but the maneuver was flown at least once to be graded. The listing of the maneuvers, the flight they were performed on, and the date they were last accomplished are located in Appendix 6. Dates and flights for a portion of the maneuvers are listed in Table 3.

Maneuver	Flight Performed	Last Accomplished
Stalls – Landing Configuration	1,2,3,7	10 Nov 2013
Slow Flight	1,2,3,7	10 Nov 2013
Vmc Demo	3,4	10 Nov 2013
Engine Shutdown/Restart	3,4,5,7	10 Nov 2013
Engine Inoperative Maneuvering	3,4,5,7	10 Nov 2013
Single Engine – VFR	5	9 Nov 2013
Landing with Most Critical Engine Inoperative	5,7	10 Nov 2013

Table 3. Date of Maneuvers performed

6.1.1.1 Stall Training and Differences from Advisory Circular 120-109

In addition to ground training, pilots are flight trained in stall recognition and recovery. Pilots must perform approaches to stalls in takeoff, clean, and landing configurations with at least one approach to stall maneuver flown while in a 15-30 degree bank turn. Accelerated stalls are performed with both flap 20 and 0 flap configurations. Pilots must recover the airplane at the first indication of a stall: either airframe buffet or the control wheel shaker. The final phase check includes three “approach to stall” maneuvers.

The accident pilot flew three training flights where landing configuration stalls were performed. In addition, he performed a landing configuration stall maneuver on his phase check flight, which took place that morning.

In accordance with the SFAR Approach to Stall flight profile, when stall recognition occurs, the pilot applies maximum engine power and adjusts pitch as necessary to minimize the loss of altitude. The procedure is different than the one outlined in the FAA’s Advisory Circular (AC) 120-109, *Stall and Stick Pusher Training*, dated August 6, 2012. The AC “emphasizes reducing the angle of attack (AOA) at the first indication of a stall as the primary means of approach-to-stall or stall recovery.” The AC changed the flight profiles for pilot certification and evaluation but does not alter the flight profiles in the SFAR. The FAA’s decision to include the flight profiles in the SFAR requires a change through the Notice of Proposed Rulemaking

(NPRM) process. To date, MU-2B instructors and evaluator must instruct in the method to minimize altitude loss. The accident pilot's instructor did teach the minimize loss of altitude method per the SFAR requirement, but also instructed on the AOA recovery method.

In addition to his exposure to both recovery methods in his MU-2B training, the pilot demonstrated knowledge of both methods of recovery in previous airplanes. The FAA's designated pilot examiner for the pilot's airplane multiengine instructor rating reported that for an instruction topic, the pilot taught stall recovery procedures, explaining both methods appropriately.

6.1.1.2 Single engine and V_{mc} Awareness Training

Like stall training, single engine procedures and V_{mc} awareness training was provided during ground and flight training and is required for completion of the flight phase check. Single engine training was performed using zero thrust on one engine or by shutting down an engine by performing an airborne (negative torque sensor) NTS test. A demonstration of V_{mc} occurred on two training flights. "One engine inoperative maneuvering loss of direction control" maneuvers were performed on three flights and on his final phase check. This maneuver required the airplane to be configured with flaps 20 and the landing gear up. One engine was set at zero thrust and the other engine was set to takeoff power. The airplane was pitched up to reduce the airspeed. As the airplane slowed to V_{mc} + 10 knots, the instructor blocked the rudder to cause a loss of directional control. At the first indication of a loss of directional control, the pilot would reduce airplane pitch and engine power to recover control of the airplane.

Single engine flight training took place on three of the training flights and on the final phase check. The pilot had performed a single engine landing on the morning of the accident during his phase check.

6.1.2 Notes Taken During Training

The pilot's handwritten notes taken during his SFAR training were found in the wreckage. A copy is located in attachment 7 of this report. Included in the pilot's notes are the following entries:

- For engine out, <u>center ball</u>
- ** <u>120 kts</u> - Never go below 1. Takeoff 2. Landing assured
- V_{xse} = 125 kts
- Single engine flight – remain clean configuration until beginning of approach segment. In approach segment, gear up, flaps 5°, then when <u>landing assured</u> (or *unreadable*), gear down, 20°
- (5° flaps) Blue line, V_{xse} 130, V_{yse} 140

6.2 Instructor's Qualification

The instructor pilot who completed the pilot's training, was SFAR endorsed. He accrued at least 16,000 hours in MU-2B series airplanes. He began instructing in the MU-2B in 1998, and

estimated about 3,000 flight hours as an MU-2B instructor. On August 4, 2013, he renewed his flight instructor's certificate and on August 31, 2013, he completed a MU-2B-20 recurrent training course.

6.3 SFAR Pilot Checklist

The SFAR lists the applicable MU-2B-25 pilot checklist as YET06248A, however, YET0628B was accepted for use by the FAA's Flight Standardization Board on May 6, 2010. The checklist includes a single page checklist, which is a condensed version of the normal procedures. The flight instructor reported that the pilot routinely flew with the single page checklist in a pouch located to the left side of the pilot's seat. The pilot checklist was normally stowed behind the co-pilot's seat on the flight deck. A fire-damaged copy of the pilot's checklist was discovered in the wreckage located near the aft facing passenger seat, aft of the flight deck. The single page checklist was not located and was likely consumed in the post-impact fire.

6.4 Unaccepted Checklist

Professional Flight Training (PFT) constructed a checklist that has not been accepted by the FAA's Flight Standardization Board. The checklist was compromised of items from the accepted checklist as well as expanded information. The flight instructor reported using the checklist solely to accomplish the first flight of training, since it contains information that the instructor finds beneficial for pilots new to the MU-2B airplane. The instructor also reported that pilots normally transition away from the PFT checklist by the second or third flight. The FAA-accepted checklist was used for the remainder of training with the PFT checklist as a supplemental training aid, if needed.

Examination of the airplane wreckage found a partially consumed PFT checklist melted to the circuit breaker panel to the left of the pilot's seat. In addition, another PFT checklist was found in the aft portion of the fuselage.

Interviews with previous pilots of the MU-2B instructor pilot reported different experiences concerning the unaccepted checklist. One former trainee reported never using the PFT checklist inflight, and emphasized that only the FAA accepted checklist was used. Another former trainee used the checklist as the sole checklist for almost every flight. His perception was that the instructor pilot wanted to use the PFT checklist for every flight.

During the course of the investigation, the cockpit of 10 MU-2s were examined[9]. Two of the airplanes had checklists other than the accepted checklist adjacent to the pilots' seats and one did not have an accepted checklist.

7.0 MU-2B-25's Instrumentation and Systems

[9] Ten MU-2B airplanes of varying models where examined by a member of the NTSB while gathering information at a repair station in Tulsa, Oklahoma.

The airplane was configured with a modified avionics system, standard engine gages, and a standard annunciator panel. An integrated avionics system consisting in part of a Garmin 600, was installed in the airplane through a supplemental type certificate. The airplane was also equipped with a stall warning system.

7.1 Garmin G600

The Garmin G600 is an integrated avionics system capable of displaying both a primary flight display and a multi-function display. The airspeed indicator is presented in a rolling tape format. The airspeed's numeric display consists of white numbers on a black background located in the middle of the rolling tape.

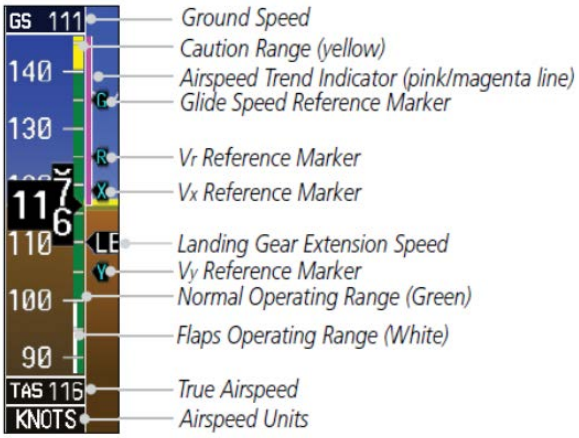

Figure 1. Exemplar Airspeed Indicator

Located on the right side of the tape is a narrow color-coded speed range strip. During installation of the system, select airspeeds are entered in the system in order to properly display the speed range tape and airspeed marker. At the bottom of the speed range tape, the tape can be colored red until V_{so}, above V_{so} the range is typically white and green or solid green to display the display's normal operating range. At V_{no} through V_{ne}, the range is typically depicted as yellow as a caution range until V_{ne} when the range tape displays a red and white "barber pole" pattern. To the right of the speed range tape is the airspeed trend indicator which is displayed as a thin magenta line extending up or down to display the predicted airspeed in 6 seconds if the current acceleration is maintained.

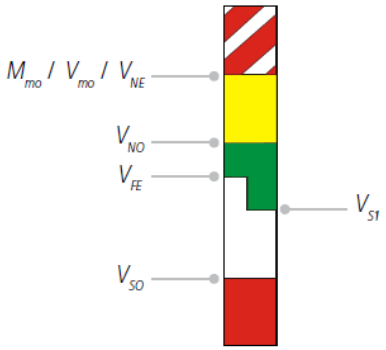

Figure 2. Exemplar Airspeed Tape Markings

Also able to be displayed is V_{yse} and V_{mc}. V_{yse} is displayed as a blue horizontal line and V_{mc} is displayed as a red horizontal line.

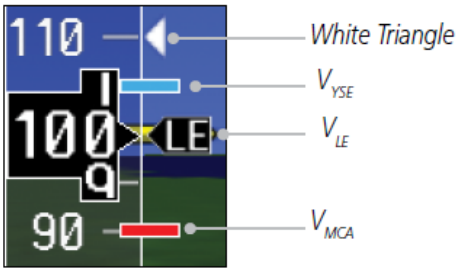

Figure 3. Example of Vyse and Vmc reference lines

The slip indicator is displayed as a horizontal line just beneath the triangle shaped zero roll scale indicator. The complete movement of the line outside of the triangle indicates the displacement equal to one ball of a conventional slip indicator.

7.1.1 Pilot's Familiarization with the Garmin G600

The pilot also owned a twin-engine Cessna 421B and had a G600 installed in the airplane in November, 2010. It is estimated that the pilot had three years and at least 325 hours flying an airplane equipped with a G600.

7.2 Cockpit Engine Instrumentation

In addition to the digital avionics displays, the airplane remained configured with numerous analog gages. The engine gages were analog displays and were located in the left center portion of the cockpit arranged in two columns. Each column displayed information pertaining to its corresponding engine (e.g. the left column's engine torque gage displayed the left engine's torque). The pilot's standby airspeed indicator, located to the left of the G600, had a white arc from 77-175 knots and a green arc from 101-250 knots. The airplane also had a yellow caution annunciator located on the center of the instrument panel shroud with the corresponding annunciator panel located on the pilot's left side panel. The postaccident fire precluded examination of the engine instruments and annunciator panel.

7.3 Stall Warning System

The airplane was equipped with a control wheel shaker stall warning system. This system uses a lift transducer on the leading edge of the right wing which actuates based on the airflow over the wing. The transducer sends an electrical signal which is compensated for the flap setting. When the airplane is approximately 4-9 knots above stall speed, a vibration or shaking motion is applied the control wheel. There are no association aural warnings with the stall warning system.

Pilots are exposed to the control wheel shaker through two manners. The control wheel shaker is tested prior to flight to ensure proper operation and pilots likely encounter the control wheel shaker while performing the approach to stall maneuvers during SFAR training.

7.4 Autopilot System

The airplane was modified with a Bendix M4D autopilot system according to supplemental type certificate SA561SO[10]. The M4D is a multi-axis autopilot which controls roll, pitch, yaw, and pitch trim. The autopilot system can be used if one engine is inoperative provided that the airplane is properly trimmed. This system was integrated with the installed avionics and passed a functional flight check [11]on November 6, 2013.

8.0 Wreckage Examination

In addition to the pilot's radio communication that he had a left engine shutdown, examination of the wreckage discovered that the left engine's fuel shutoff valve was in the closed position. The examination did not detect any other anomalies with either engine.

Examination of the airframe revealed that the airplane was configured with the landing hear extended and flaps at the 20 degree position. No anomalies were detected with the airframe or the flight control systems.

8.1 RCS Switches

The fuel shutoff valve is electrically actuated through the Run-Crank-Stop (RCS) switch located on the center pedestal between the power and condition levers. The switch is a three position gated switch with a single gate between the run and crank positions. The switch is spring loaded to move the switch from the stop to the crank position. During normal operations, the switch is moved to the run position for engine start and not moved until the engine is shutdown on the ground. Two RCS switches exist, one for each engine.

The pilot was knowledgeable of the RCS switch locations and function within the systems of the MU-2B-25. During flight training, each engine was shut down on separate occasions using the RCS switch. The pilot performed at least one shut down inflight using the RCS switch to demonstrate proficiency to perform an airborne NTS check.

The only switches similar to and in the vicinity of the RCS switch, circle in red on Figure 4, are two gated switches main fuel valve switches, two gated engine power auto limit switches, and two gated ignition switches, each set circled in yellow. The main fuel valve switches and engine power auto limit switches are two position switches with a single gate. These switches are located to the left of the center pedestal and behind and to the right the pilot's control wheel. The ignition switches are three position switches with two gates to select continuous, off, or auto ignition. These switches are located to the right of the center pedestal.

[10] FAA Airworthiness records dated May 8, 1974.
[11] FAA Airworthiness records dated November 6, 2013

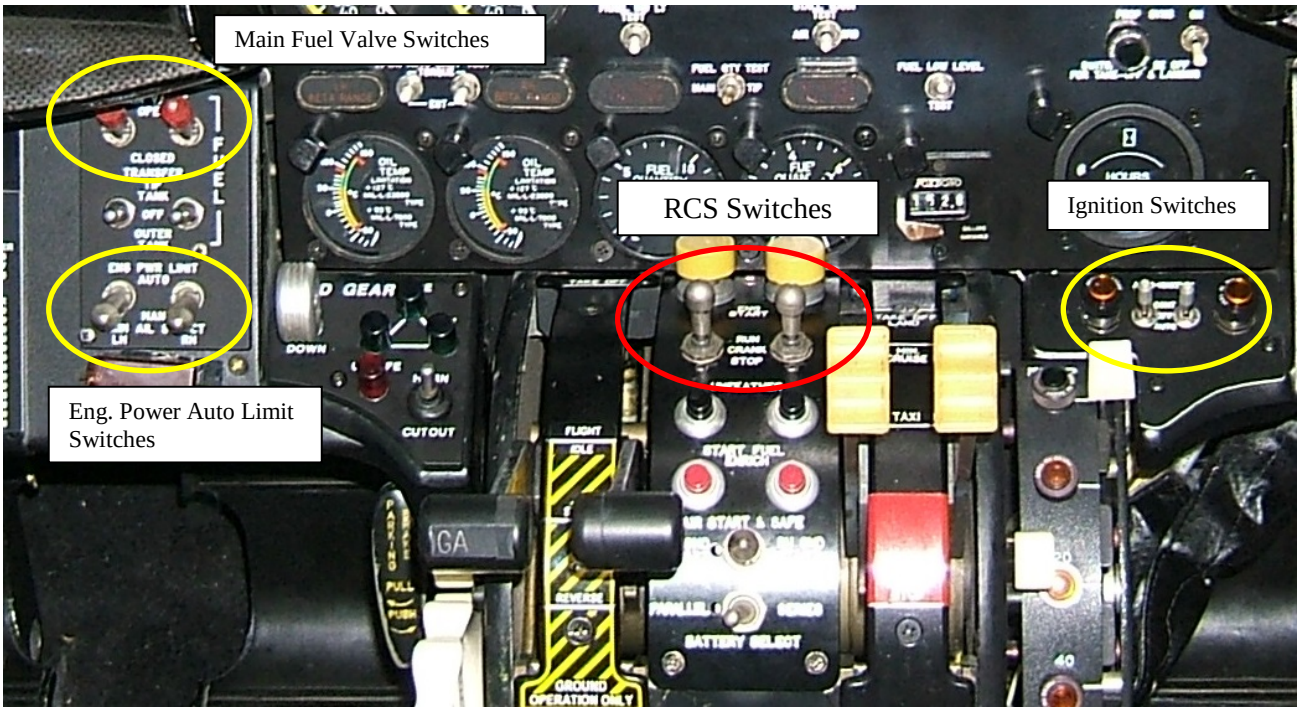

Figure 4. Location of Switches

8.2 Pilot Checklist for Engine Shutdown

The first two steps of the *Engine Shutdown* checklist are highlighted steps which are emphasized as procedures that the pilot would be expected to comply with by memory in the event of an actual malfunction. The two highlighted steps are:

Conditional Lever (failed engine) …….EMERGENCY STOP
Power Lever (failed engine) ……..TAKEOFF

The rest of the checklist is not performed by memory and includes a step directing "Power (operating engine)" set "As Required."

9.0 Comparison Between Airplane Types

Although the pilot had recent experience in the accident airplane, he owned and flew a Cessna 421B. The 421B was configured with a Garmin 600 with a digital display similar to the accident airplane.

The Cessna 421B's engine instrument is arranged horizontally on the upper center of the cockpit instrument panel unlike the MU-2B which is arranged vertically. Rather than individual engine gages, the 421B has dual pointers on each gage labelled "L" and "R" to discern between the engine readings unlike the MU-2's engine gages which were arranged in two columns.

Figure 5. Photo of engine gages from pilot's Cessna 421B

Figure 6. Photo of N856JT's engine gages

The Cessna 421B's stall warning consists of an aural warning horn which sounds between 5-10 knots above the stall at all configurations. The MU-2B does not have an aural stall warning horn, nor was it required to.

10.0 Additional Information

10.1 Airplane Purchase

The pilot's wife could not recall when the decision to purchase an MU-2B was finalized. The pilot was looking for an airplane that could cruise faster and be a "smoother ride" than the Cessna 421B. He considered other airplanes, but settled on the MU-2B due to its price point.

Initially, the pilot sought a “long body” version of the MU-2, and negotiated the purchase of an MU-2B-60. However, he was unable to secure the purchase of that airplane, so he later negotiated to purchase N856JT due to the similar avionics configuration of his Cessna 421B, and the airplane’s maintenance history. Initially, he set a price point based on the intention of overhauling the propellers and performing a pre-buy inspection. The previous owner countered that the propellers had accrued less than 1,200 hours and that the airplane’s recently completion inspection would be the best pre-buy inspection. The pilot considered these points, talked with personnel at the repair station that performed the maintenance, and agreed to forgo the overhauls and pre-buy inspection. On September 21, 2013, the pilot and previous owner agreed on a price and on September 25, the airplane was registered to the pilot’s LLC.

10.2 Airplane Inspection

Maintenance records maintained at Intercontinental Jet Service Corporation contained documentation of a concurrent 100-hour and annual inspections completed on September 19, 2013. At the time of this inspection, the airframe accrued 6,581.4 hours, and each engine had 936.4 hours since overhaul.

G. LIST OF ATTACHMENTS

Attachment 1: Records of Conversation
Attachment 2: Transcript of the interview of the MU-2B instructor
Attachment 3: Interview of spouse for pilot’s 72-hour history
Attachment 4: Witness statements
Attachment 5: Toxicology
Attachment 6: List of maneuvers flown
Attachment 7: Pilot’s notes